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(54) Vapour dispensing devices

(57) Vapour dispensing devices for the controlled release of vapours to the atmosphere comprise a reservoir 4 with optionally an absorbent support 6 and a capillary outlet 5 controlling the rate of vapour emission.

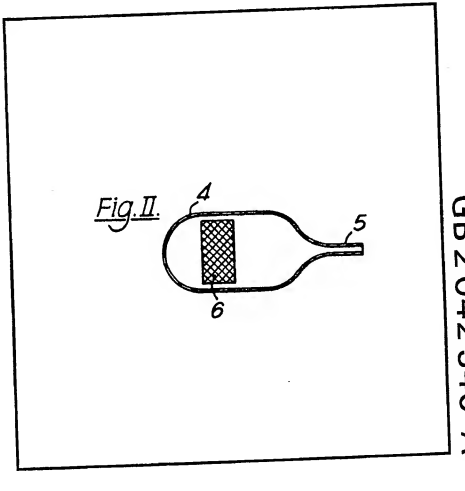

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Fig.I.

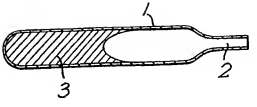


Fig.II.

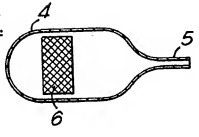


Fig.III.

Fig.IV.

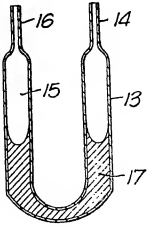
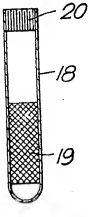
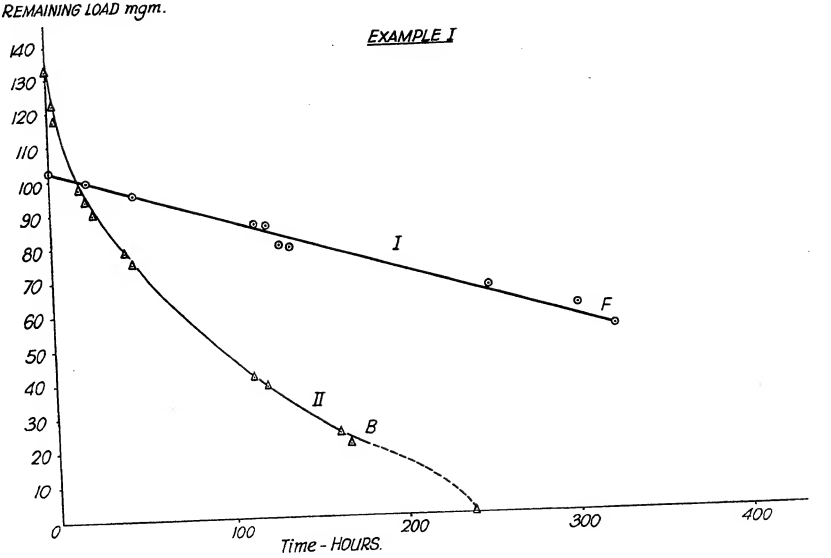


Fig.V.




REMAINING LOAD mgm.
EXAMPLE I
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
100
200
300
400
Time - HOURS.
I
F
II
B

SPECIFICATION

Vapour dispensing devices

This invention relates to vapour dispensing devices. More particularly, the invention is concerned with devices designed to dispense, in small and controlled amounts, vapours into the atmosphere.

Primarily, the devices are useful in the control of insect pests, but the invention is not restricted to this application and is of use in providing a means for achieving a substantially uniform rate of vapour emission from a reservoir of the appropriate substance, such as a space deodorant, a perfume or an insecticide, the vapour of which is to be dispensed. Such substances also include those present naturally in the attractant pheromones of insects; substances which, although not pheromones, have been found by trials to attract certain insects; substances which inhibit or confuse insects exposed to pheromone emissions from their own species and substances which repel or deter insects.

In general it is found that there is a minimum quantity of such a substance which must be perceived by an insect for its behaviour to be affected. Conversely, in some instances an excessive quantity of the active substance may not produce the intended results. Furthermore, many of the potentially useful substances are difficult to manufacture and are consequently highly priced. The ideal vapour dispensing device is therefore one which gives a sustained emission of the active substance at a substantially uniform and appropriate rate.

Many examples of sustained, controlled release systems are known in the prior art. Thus active chemicals may be dispersed from one homogenous solid or semi-solid phase in which the attractant is dissolved or dispersed, the active material may be released through the walls of a container or encapsulant, etc. Each of these systems has its advantages and disadvantages.

One general disadvantage of many such systems is that the parameters of the systems which determine the rate of emission change as the quantity of residual active substance diminishes. In some of the systems the concentration of the active substance is a controlling factor. In the closed end capillary systems described in US Patent No. 4,017,030 the controlling parameter includes the unfilled portion of the capillary which naturally lengthens as the contents escape by gaseous diffusion. Indeed, although the inventor of US Patent No. 4,017,030 claims a stable emission rate after an initial period which, in the examples given is of the order of 24 hours, it is clearly demonstrated by the data and figures of this patent that about half of the active substance originally held in the device is emitted in the early stages at rates which are greatly in excess of the effective rate.

The present invention therefore provides a dispensing device which does not have the limitations inherent in the previously-known capillary devices and can, in certain forms, provide a very long-lasting dispensing system.

Accordingly, the present invention provides a dispensing device for vaporisable substances comprising a reservoir containing the vaporisable substance and at least one capillary passage connecting the reservoir with the atmosphere, said capillary passage constituting an emission rate controlling device for the vaporisable substance and having a cross-sectional area of less than half that of the reservoir.

Capillary passage in this context describes a passage of narrow or small cross section and includes not only passages with a circular cross section but also substantially rectangular sections such as may be obtained by deforming a circular tube, annular cross sections obtained by inserting a cylinder into a tube and other cross sectional shapes providing comparable constraints on the diffusion of vapours.

The capillary passage may be an orifice formed in the wall of the reservoir providing its dimensions permit it to function as an emission rate controlling device.

The absolute dimensions of the controlling capillary will depend on the desired rate of vapour emission and on the physical properties of the vaporisable substance.

In the devices according to this invention, the capillary passage will be fed with an effectively constant concentration of vapour from the reservoir and, since the capillary passage is constant in dimensions, the rate of emission will be similarly constant.

It will, of course, be appreciated that changes in ambient temperature will affect the rate of emission, but excluding this factor, the changes in the rate of emission are practically negligible.

If the vaporisable substance is a liquid it can be retained in the reservoir by capillary action if the surface tension of the liquid and the dimensions of the reservoir permit this. Alternatively a liquid which cannot be retained in the reservoir by capillary action may be absorbed into a microporous solid material enclosed within the reservoir so keeping the vaporisable material in a freely vaporisable liquid store, away from the emission rate controlling capillary of the device.

The dispensing device may clearly be made of any appropriate material such as glass, ceramic, plastics or metal material, but if adequate control of the rate of emission is to be obtained, the material from which the device is constructed must clearly be largely impervious to

the vaporisable material.

Various forms of the dispensing device provided by this invention will now be described in greater detail with reference to Figs. I to V of the accompanying drawings which are not to scale.

Fig. I illustrates a simple dispensing device comprising a reservoir zone 1 leading to a capillary emission rate controlling zone 2. The vaporisable material is indicated at 3 and it will be appreciated that the vapour from the liquid 3 fills the part of the reservoir 1, which is not cross-hatched, and also the capillary zone 2. Since the reservoir 1 typically has a cross sectional area of 0.79 sq. mm. and the capillary zone has a cross sectional area of 0.13 sq. mm. and a length of 20 mm. it will be understood that the rate of emissions of vapour from the device is primarily controlled by the terminal capillary and will be substantially constant until the supply of liquid is exhausted.

Fig. II illustrates a modification of the device in Fig. I. The reservoir zone is indicated by 4 and the capillary zone by 5, and a macro-porous support 6, made of suitable inert materials such as sintered glass, cellulosic or viscose fibres in plug or sheet form and the like, carries the vaporisable material. One particularly useful material for this function is a cellulosic cigarette filter, solid under the Trade Name "Filtrona Transorb", and supplied by Cigarette Components (UK) Limited. Again, the vapour from support 6 completely fills the reservoir zone 4 and supplies a continuous feed of vapour to the capillary zone 5.

When very small quantities of vaporisable liquid are to be dispensed, in for example, sub-milligram quantities, a small piece of cellulosic sheet less than 1 cm. sq. is satisfactory. The absorbent sheet may be crimped or coiled as appropriate provided that its major surfaces are freely exposed to facilitate evaporation and unimpeded diffusion of the vapour.

Fig. III illustrates an alternative form of the device, comprising a waisted tube having capillaries at either end. The device comprises a reservoir zone 7, leading to a capillary emission controlling zone 8, a further reservoir zone 10, leading to a capillary 9 and a waisted zone 11, linking the reservoirs 7 and 10. A vaporisable liquid is indicated by cross-hatching and is located around the waisted portion 11 and in the linked reservoirs 7 and 10 by capillary action.

Fig. IV illustrates a further modification of Fig. III, comprising a U-shaped tube formed to make a reservoir zone 13, communicating with a capillary zone 14, and a reservoir 15 communicating with a capillary zone 16. The base of the U-tube contains the vaporisable material 17.

Fig. V illustrates a further modification of the device illustrated in Fig. II, in which a reservoir 18 contains a porous support 19, in which is absorbed the vaporisable material. The upper end of the reservoir 18 is provided with a series of emission rate controlling capillaries in the form of an insertable plug 20. These multiple capillaries may conveniently be provided by the use of macroporous materials, including sintered glass and ceramics, porous plastic sheeting and the like to form the plug 20. This device is of particular value when a relatively high rate of emission is required, or for vaporisable liquids of low volatility, since vapour from the support 19, carried in the reservoir 18, communicates uniformly to the capillaries in plug 20, so giving a constant, relatively high discharge from the device.

The various devices provided by this invention may be filled using any appropriate technique.

For example, devices of Figs. I and II may be filled by evacuation and *partial* release of vacuum with the devices submerged in the liquid. This introduces liquid into the capillary and the reservoir. Finally, completely releasing the vacuum displaces liquid from the controlling capillary.

For devices of both Figs. II and V the plug of absorbent material may be loaded with liquid and placed in devices of this type which are made in two parts, for example, by making one portion a telescope fit into the other.

Devices of Figs. III and IV can be loaded as described for Fig. I or by applying suction to one end so that one of the two reservoirs compartments is filled and the other not. The device is then brought clear of the feed liquid and suction applied further to bring the liquid into a central position round the middle construction.

The devices provided by this invention may be mounted in appropriate insect traps and may be used to attract insects for counting purposes or, if associated with insecticides, to attract and kill insect pests.

Example 1

A device as described in Fig. I was loaded with chloroform. The reservoir had a bore of 1 mm. and was 80 mm. long, the controlling capillary was of 0.4 mm. bore and was 20 mm. long.

A second tube with a bore of 1 mm. and 100 mm. long, closed at one end as described in US Patent No. 4,017,030, was similarly loaded with chloroform. Both tubes were exposed to atmosphere in a laboratory and the rates of evaporation of the chloroform were measured.

The attached graph shows the weights of chloroform remaining in each device plotted against

elapsed time.

The tube with a controlling capillary gave a fairly uniform rate of evaporation as shown by the straight line marked I. The tube in accordance with US Patent No. 4,017,030 initially lost weight rapidly and the weight plot marked II is curved showing that the rate of evaporation was not constant. Thus the mean rate for the uncontrolled tube was 2 mgm./hr. over the first 20 hours but fell to 0.3 mgm./hr. after 120 hours. With the controlling capillary a uniform evaporation of just over 0.1 mgm./hr. was achieved throughout.

Example 2

A device as described in Fig. I was loaded with a mixture of 1.045 gm. benzene and 1.056 gm. toluene and exposed to atmosphere in a laboratory and the rate of evaporation was measured by weighing the device and its contents. The controlling capillary had a bore of 0.1 mm. and was 10 mm. long.

Table I shows the weights of the contents of the device against elapsed time and as is shown the emission rate was virtually linear over a period of six weeks at an average of 0.014 gm. per day.

Actual daily losses were measured on thirteen separate days. The mean daily loss was 0.0141 gm. with a standard deviation of 0.001 gm.

Table I

Weight of residual liquid (gms.)	2.10	2.09	2.07	2.055	2.04	2.00	1.99	1.97	1.96
Time (days)	0	1	2	3	4	7	8	9	10
Weight of residual liquid (gms.)	1.94	1.90	1.89	1.87	1.79	1.76	1.75	1.52	
Time (days)	11	14	15	16	22	24	25	42	

Example 3

These experiments show the effect of using an excessively large and incorrectly shaped porous support.

Two devices of the type described in Fig. I were loaded with 2 mgm. of cis-9-tetradecen-1-yl acetate supported on a cylindrical plug of cigarette filter tip material approximately 25 mm. long and 5 mm. diameter. The total volume of the support was about 0.5 ml., that is approximately 200 times the volume of the liquid charge. Device A has a reservoir of 0.8 ml. capacity, device B had a reservoir of 3.5 ml. capacity. Both had cappilaries, 10 mm. long, 1 mm. bore.

Evaporation was monitored by weighing the charged devices.

	Device A	Device B
Time to evaporation of 1 mgm.	21 days	25 days
Time to evaporation of 1.6 mgm.	60 days	60 days

Thus the rate of evaporation was not linear and was affected by the additional restraint of diffusion through the bulk of the porous support. The ratio of the volumes of the container and the supports did not have a significant effect.

CLAIMS

1. A dispensing device for vaporisable substances comprising a reservoir containing the vaporisable substance and at least one capillary passage connecting the reservoir with the atmosphere, said capillary passage constituting an emission rate controlling device for the vaporisable substance and having a cross-sectional area of less than half that of the reservoir.
2. A device as claimed in Claim 1 in which the reservoir is provided with a macro-porous support on which the vaporisable liquid is carried.
3. A device as claimed in Claim 2 in which the macro-porous support is a cellulosic plug.
4. A device as claimed in Claim 2 in which the macro-porous support is in cellulosic sheet form.
5. A device as claimed in any one of the preceding claims in which the vaporisable liquid is a pheromone.

6. A device as claimed in any one of the Claims 1 to 4, in which the vaporisable liquid is an insecticide.

7. A device as claimed in any one of the Claims 1 to 4 in which the vaporisable liquid is a space odorant.

8. An insect trap for insect population surveys, having mounted in it a device as claimed in Claim 5.

9. An insect trap having mounted in it devices as claimed in Claim 5 and Claim 6.

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